

## HEARING AID

The present invention relates to a hearing aid to be placed in the auditory canal, comprising a housing provided with a microphone, an amplifier, a loudspeaker and a battery compartment, said housing being provided on one side with means for removing said hearing aid from the ear, and is provided on the other side with sound transmission means for the transmission of sound from said loudspeaker into the auditory organ.

Such a CIC (completely in channel) hearing aid is known from PCT Application WO 99/13686 in the name of L.G. Bordewijk. Such a device must be distinguished from more conventional hearing aids, which are fitted in or near the pinna of the person concerned.

Fitting the device at a deeper level in the auditory canal has not only optical advantages, but also acoustic advantages.

PCT Application WO 01/41503 also discloses a hearing aid for fitting in the auditory canal, which hearing aid is composed of two parts, the first part being a standard part provided with a relatively rigid plastic standard housing, in which microphone, amplifier, loudspeaker and battery compartments are accommodated. The second part, made of a more flexible plastic material, is adapted to the specific auditory canal of the individual patient.

Until now different hearing aids have been used for the left and right ear, and it was found that neither of these hearing aids was a totally satisfactory fit.

It is the object of the present invention to avoid these disadvantages and provide a hearing aid that can be used on either side.

This object is achieved in the case of a hearing aid of the type described above by the fact that the head end face of said one side is provided in the center with the input of said microphone.

The hearing aid according to the invention can comprise any type of hearing aid for placing in the auditory canal of a patient. All that is important is that the hearing aid be of a slightly curved design, in order to adapt better to the auditory canal of a patient. According to an advantageous embodiment, the head end face facing outwards is designed in such a way that cosmetically it makes no difference that the standard part in the one ear is in fact rotated 180 degrees relative to the other ear.

The operating elements and their position on said end face are disposed in such a symmetrical arrangement that the 180-degree rotation makes no cosmetic difference to the end result. The microphone input is made in the center, so that the rotation makes no difference whatsoever even to it, and therefore makes no acoustic difference between the one ear and the other. The two other apertures on the end face contain operating elements which do differ, but because of the 180-degree rotation this difference is not noticeable, owing to the fact that these are apertures of exactly the same size that are placed exactly symmetrically.

On the face of it, viewed from the outside, and as a result of the symmetrical arrangement of the end face, the hearing aid on the right will have the same cosmetic profile as the hearing aid on the left. As a result of this design, the fit on the left and on the right, and therefore the positioning in the auditory canal and the appearance of the hearing aid, is the same on both sides of the head, while technically the same hearing aid standard part is still being used on the left and on the right.

According to an advantageous embodiment of the present invention, the hearing aid is composed of a standard part made of a relatively rigid plastic material and a second part that is adapted to the auditory canal of the patient. The rigid plastic part, which provides good protection for the electronic components, according to the present invention is universal, in other words designed for use either on the right or on the left. The more flexible plastic part that is designed to fit the auditory canal of the patient is, of course, dependent upon the auditory canal concerned.

Such constructions must be distinguished from constructions in the case of which a part of the hearing aid is fitted outside the auditory canal. Such a hearing aid is composed of a part that is placed in the ear and is custom-made for the patient concerned, and of a module to be placed on it that is universal. This module can be used either on the left or on the right.

According to an advantageous embodiment, the first central axis provided through said one side and the second central axis provided through said second side form an angle  $\alpha$  of at least  $10^\circ$ .

Surprisingly, it has been found that in general two types of hearing aid will suffice. A type by means of which the majority of patients can be helped is one in which the angle between the one side and the other side is approximately  $45^\circ$ . Another type that can be used by certain users is that in which said angle is approximately  $15^\circ$ .

In general, the abovementioned angle lies between 10 and  $45^\circ$ .

Surprisingly, it has been found that the hearing aid designed in a reliable way can be used on either the left or the right ear. In other words, a number of components of a hearing aid can be used universally, which considerably reduces the cost.

The hearing aid can be composed of two parts, in other words a universally usable housing and an end piece that is fitted on the other side, in which end piece in particular the sound channel is situated, and which can be adapted to the individual.

According to a further advantageous embodiment, the head end face of the one side, in other words the head end face facing outwards, is provided with an ON/OFF switch of the hearing aid. Furthermore, said head end face is preferably provided with some kind of adjusting means or means that make adjustment possible. These adjusting means can comprise a potentiometer and/or a connection with any software that may be present in the hearing aid.

According to a further advantageous embodiment, the cross section of the hearing aid is preferably oval, and more particularly is elliptical (symmetrically oval).

Furthermore, one part is provided with means for the removal of the hearing aid, which means are preferably manufactured by injection molding. The other side can likewise be provided with such means, which serve as an aid if the hearing aid becomes detached in the auditory canal, or if the first means for the removal should unexpectedly fail.

The invention will be illustrated below with reference to preferred embodiments. In the drawing:

Fig. 1 shows diagrammatically in perspective a first embodiment of the hearing aid according to the invention; and

Fig. 2 shows an end view of the hearing aid according to Fig. 1.

A hearing aid is indicated in its entirety by 1 in Fig. 1. This hearing aid is composed of an internal part 2 and an external part 6, which can also be indicated as a housing. The internal part is composed of a connecting part for connection to the housing 6 and a part 4 adapted to the specific geometry of the auditory canal of the patient concerned. Sound channel 10 is fitted in part 4.

The external part 6 is preferably composed of a rigid plastic housing, in which electronic components are accommodated. According to the present invention, this part is a standard part that can be used for either the left or the right ear. The internal part is designed depending on the present auditory canal of the patient.

A space for battery 5 is bounded between the internal part 2 and the housing 6. Battery 5 is accommodated in a compartment of the housing 6 not shown in any further detail. A microphone, an amplifier (digital or otherwise) and a loudspeaker, which are not illustrated, are also present in housing 6. Connection to the environment is achieved by way of the sound aperture 11. As can be seen from Fig. 2, said aperture is provided in the end face of the housing. The head end face is indicated by 14. Aperture 11 is positioned centrally, in other words whatever the position of the housing 6 is, aperture 11 will always have the same position relative to the pinna of the patient concerned. Reference numeral 7 indicates a pull rod, which is connected to the housing and is made by injection molding. This pull rod is preferably transparent and serves to remove the hearing aid from and/or position it in the auditory canal.

The central axis of the internal part 2, described above by other side, is indicated by 8. This central axis is preferably in a position perpendicular to the end face of the internal part. The longitudinal axis of the housing, indicated above by one part, is indicated by 9. This longitudinal axis is preferably in a position perpendicular to the head end face of the external part of the housing. The angle between said axes is indicated by  $\alpha$  and according to the invention is preferably greater than  $10^\circ$ , and lies more particularly either at approximately  $15^\circ$ , or preferably approximately  $45^\circ$ .

It can be seen from Fig. 2 that a switch 12 is also present in the end face 14, for switching on/switching off the hearing aid. An adjusting facility 13 is also present. In the present case this is a connector for connection to a computer or the like for setting the sound characteristics and the sound level of the amplifier fitted in the housing 6. It can be seen from Fig. 2 that the outer boundary is symmetrically oval, and more particularly is elliptical.

As shown in Fig. 2, the construction according to the invention is mirror symmetrical in end view, in other words the same view is achieved on rotation through  $180^\circ$ . The same preferably applies to the remaining part of housing 6. This housing 6 is a universal housing and is dimensioned in such a way that it can be placed in two positions, in other words on the left and on the right, in the smallest auditory canal existing. Part 3 is adapted specifically to the patient concerned and to the auditory canal concerned (left or right). In other words, part 6 will generally be smaller than the available space in the auditory canal, with the result that it is possible to insert the hearing aid according to the invention at a deeper level in the auditory canal than is the case with existing hearing aids. This is because the curved shape of

the auditory canal does not constitute any obstruction, owing to the fact that part 6 is made smaller than this canal. In order to make it all function properly, it is, of course, important for the end face to be in a position perpendicular to axis 9. Only in those circumstances can full symmetry be ensured.

Variants that lie within the scope of the appended claims will spring to mind in the case of the person skilled in the art after reading the above.